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CLASSIFICATION:

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IN REPLY TO RFP CC NO:
N/A

ACTION ITEM STATUS
☐ OPEN ☐ CLOSED
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RF-46469 (Rev. 3/93)

EG&G ROCKY FLATS

EG&G ROCKY FLATS, INC.
ROCKY FLATS PLANT, P.O. BOX 464, GOLDEN, COLORADO 80402-0464 • (303) 966-7000

August 20, 1993

93-RF-10295

000016354

Richard J. Schassburger
Acting Director
Environmental Restoration Division
DOE, RFO

Attn: S. R. Grace

EG&G ROCKY FLATS SOIL SAMPLE FOR PLASMA MELTER TESTING AT LOCKHEED ENVIRONMENTAL, LAS VEGAS, NEVADA - TCG-164-93

Enclosed is a summary of the testing procedures to be performed on Rocky Flats soil at Lockheed Environmental this summer. This testing is being accomplished under an EG&G Idaho Falls contract associated with the remediation of Pit 9. The Proof of Process (POP) Demonstration Test being performed by Lockheed Environmental for EG&G-Idaho Falls will be broken into five test areas, two of which will use Rocky Flats soil. A schedule for completing the testing is enclosed (Attachment A).

The first test that will use Rocky Flats soil is the Pu Solubility Test. This test involves hazardous organic removal via the B.E.S.T. process. The B.E.S.T. process, a solvent extraction technique which uses triethylamine (TEA) for the removal of hazardous organics from soils, is the Best Demonstrated Available Technology for this application. The B.E.S.T. process has yet to be demonstrated on Plutonium contaminated soils; consequently, Pu solubility in TEA is not established. A bench scale test will demonstrate the solubility of Pu in TEA. A description of the process and the operating procedures is attached (Attachment B).

The second test that will use Rocky Flats soil is the Plasma Melter Test. In this test, a Laboratory Plasma Melter will be fed Pu contaminated soil. The tests will be conducted to determine the extent of Plutonium volatilization. A description of the process and operating procedures is attached (Attachment C).

EG&G Rocky Flats is contributing approximately 20 Kg of Pu contaminated surface soil toward both tests. The soil has been excavated from Operable Unit No. 2, directly east of the 903 Pad. The Pu solubility tests were performed in July, 1993 at Lockheed's remediation testing laboratory in Las Vegas, NV. The Plasma Melter tests began during the second week in August, 1993 at the ReTech facility in Ukiah, CA. I will travel to Lockheed during the testing period to observe the procedures. If you have any questions regarding these procedures, please call R. E. Madel of Environmental Engineering & Technology at extension 6972.

T. C. Greengard
Manager
Environmental Engineering and Technology

REM:cet

Attachments:
As Stated (3)

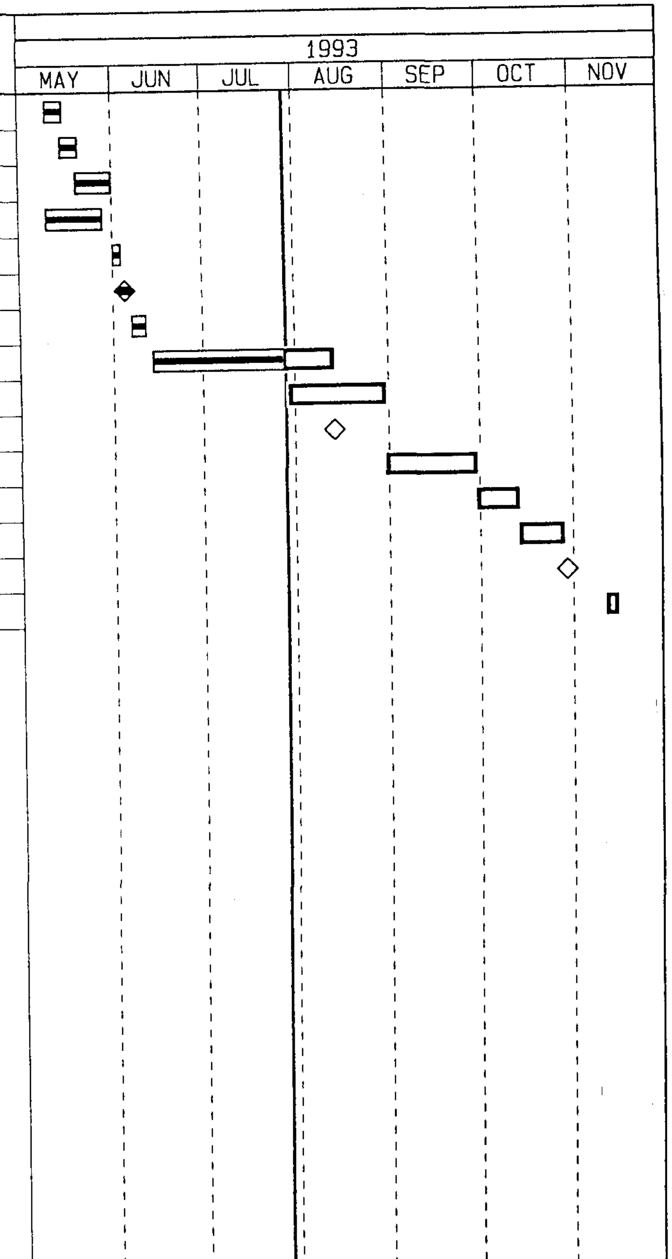
Orig. and 1 cc - R. J. Schassburger

ADMIN RECORD

SW-A-002684

Attachment A

ACT. ID	ACTIVITY DESCRIPTION	REM DUR	TOTL FLT	EARLY START	EARLY FINISH
RM010	RAD SCREEN SAMPLING	0		10MAY93A	15MAY93A
RM020	GAMMA SPEC ON RAD SCREENS	0		15MAY93A	20MAY93A
RM030	OBTAIN PACKING INSTRUCTIONS	0		20MAY93A	31MAY93A
RM040	OBTAIN APPROVAL FOR SAMPLING DCN	0		10MAY93A	28MAY93A
RM050	OBTAIN TREATABILITY SAMPLES	0		1JUN93A	3JUN93A
RM060	SEND SAMPLES TO LOCKHEED	0			4JUN93A
RM070	SCHEDULE RESERVE	0		7JUN93A	11JUN93A
RM080	Pu SOLUBILITY TESTING	12	0	14JUN93A	13AUG93
RM090	PLASMA MELTER TESTING	22	0	30JUL93	30AUG93
RM100	OBSERVE TESTING AT LOCKHEED	0	10		13AUG93
RM110	DATA ANALYSIS (LOCKHEED)	21	0	31AUG93	29SEP93
RM120	SCHEDULE RESERVE	10	0	30SEP93	13OCT93
RM130	RECEIVE REPORTS FROM LOCKHEED	11	0	14OCT93	28OCT93
RM140	LOCKHEED REPORT TO DOE	0	11		29OCT93
RM150	ANNUAL REPORT PREPARATION	2	0	12NOV93	15NOV93



Plot Date 29JUL93
Data Date 29JUL93
Project Start 1JUN93
Project Finish 15NOV93

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

SWTS ROBN

Sheet 1 of 1

EG&G ROCKY FLATS
PLASMA MELTER PROJECT

Date	Revision	Checked	Approved

ATTACHMENT B

Plutonium Solubility in Triethylamine

The B.E.S.T. process, a solvent extraction process which uses Triethylamine (TEA) for the removal of hazardous organic constituents from soils and sludge, is the Best Demonstrated Available Technology for this application. There is voluminous data to support its use for the purpose of hazardous organic extraction. Nevertheless, the B.E.S.T. process has yet to be demonstrated on Pu contaminated soils. The solubility of Pu in TEA is not established. This information is necessary to determine if Pu concentrations will accumulate in the recycle TEA and present criticality concerns. A bench scale test will demonstrate the solubility of Pu in TEA. This test will be performed at Lockheed's remediation testing laboratory in Las Vegas, Nevada.

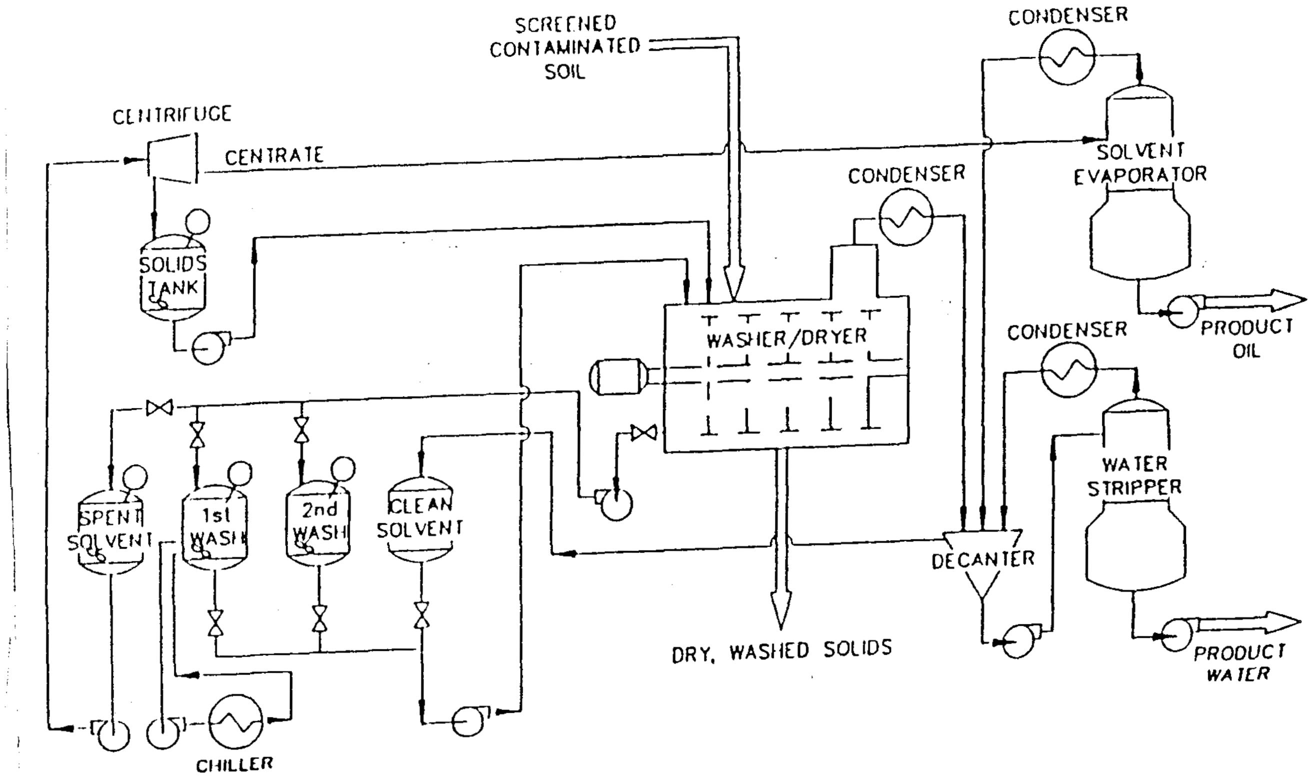
Process Description

A schematic of the B.E.S.T. soils processing unit is provided in Figure 1 (Robbins, 1990). A single vessel is used for multiple extractions, and product solids drying and conditioning, thereby minimizing materials handling operations. The B.E.S.T. solvent is contacted with the soil in the washer/dryer vessel and removed by decantation. The solvent is then recovered and recycled to the process.

The B.E.S.T. solvent is triethylamine (TEA), which is a non-regulated and unlisted solvent under RCRA. TEA is biodegradable and is totally miscible with water at temperatures below 15°C. Therefore, cold TEA can simultaneously solvate hydrophobic contaminants and hydrophilic contaminants. In the B.E.S.T. process, this principle is exploited by mixing contaminated media with the solvent to create a single phase extraction medium which is a homogenous mixture.

Once the extraction of soluble organics is complete, the particulates are removed by either filtration or centrifugation and the solids are dried of solvent. The cold, single phase solution of TEA and hydrocarbon is heated to approximately 54°C to separate water in the feed from the solvent and the extracted hydrocarbons. The separated aqueous and organic phase fractions are stripped of TEA, yielding 1) water which is free of soluble organics and 2) a soluble organic fraction that contains essentially all of the hydrocarbons present in the contaminated feed. The volume of extracted soluble organic, which is now virtually free of particulates and water, can be recycled or disposed of effectively and economically (Robbins, 1990).

Figure 1
B.E.S.T. Soil Cleanup Unit Schematic



Plutonium Chemistry

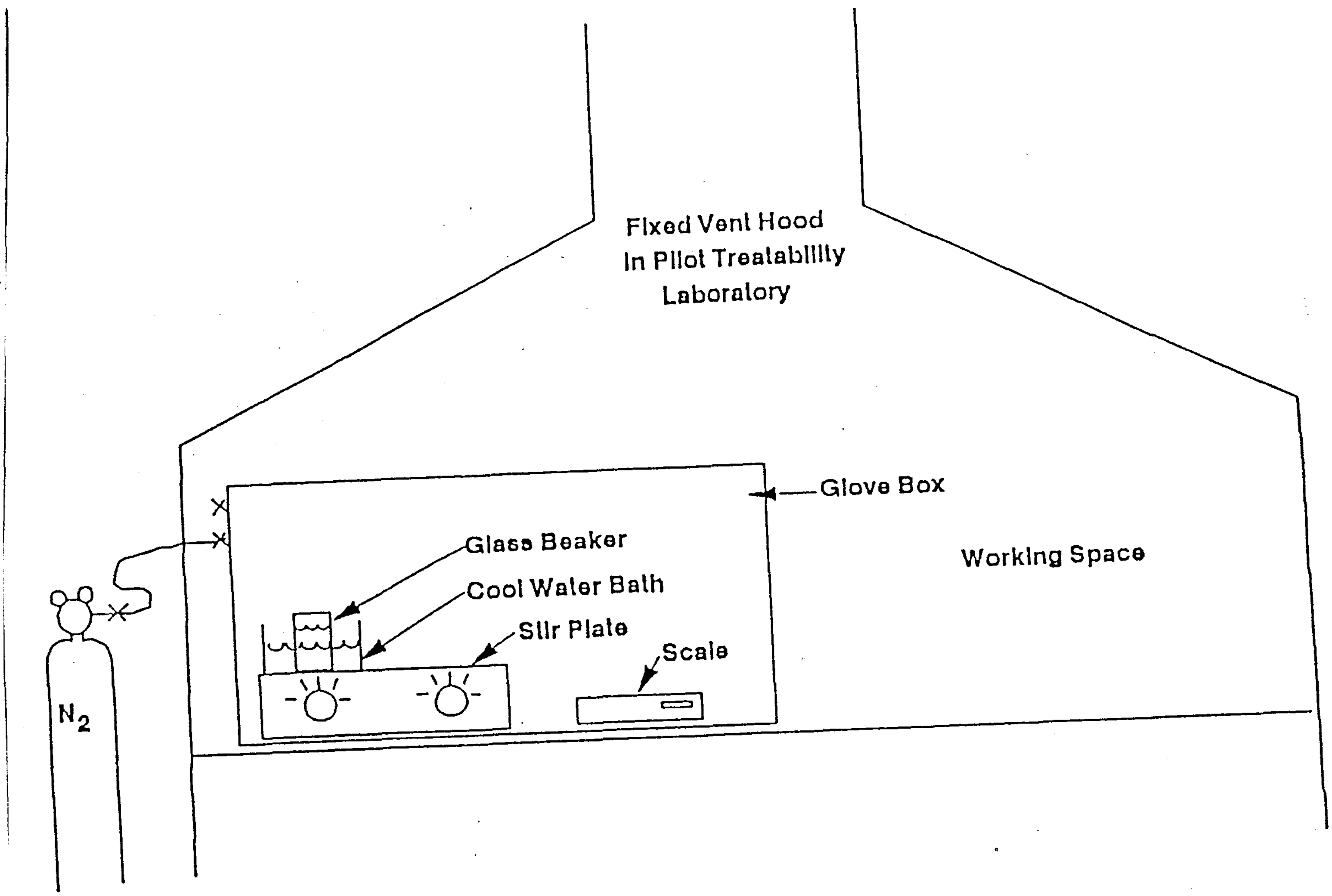
Plutonium has four valence states: (III), (IV), (V), and (VI). States (III) and (IV) are most commonly observed, both in solution and in solid compounds. Rocky Flats surface soil has remained undisturbed long enough to allow hydrolysis to occur, therefore, plutonium is expected to be in the form of PuO_2 (state (IV)). The solubility of PuO_2 in TEA has not been established; however, the plutonium is not expected to solubilize into the TEA extract.

TEA/Pu Solubility Test Description

Plutonium contaminated soils from Rocky Flats will be evaluated in a bench top beaker test. Approximately 5 kilograms of soil containing a Pu activity of about 2 nCi/g, will be used in this test. The soil will be screened and sieved to 50 mesh to eliminate the coarse particles. Multiple sub-samples of the fine soil will be taken. Standard statistical analyses will determine the homogeneity of Pu contamination of the soil. If the soils are found to heterogeneous, they will be ground to insure homogeneity. Data obtained from the test will consist of alpha spectrometry results for plutonium in both soil and liquid media. The data will be reported in pCi/g (solids) and pCi/mL (aqueous), at detection limits of 1 pCi/g and 1 pCi/mL, respectively.

Due to the flammability of TEA and the toxicity of plutonium, the test will be performed inside a glove box and vented through a snorkel into a HEPA-ducted fume hood (Figure 2).

Figure 2
Pu Solubility Test Set-Up



ATTACHMENT C

Plutonium Volatility in the Plasma Melter

Vitrification, the process of converting materials into a glass or glass-like substance, will be used at Lockheed to treat contaminated soils. Vitrification technologies can be divided into two categories: electric process heating and thermal process heating using fossil fuels. Electric processing can be divided into three primary groups: (1) joule heating, (2) plasma heating, and (3) microwave heating. In the test at Ukiah, a bench scale plasma melter will be used to determine the volatility of Pu in contaminated soil (EPA Handbook, 1992).

Plasma Melter Description

Plasma heating is an electrical heating process which relies on the conversion of a gas into a plasma through the application of energy by an electric arc. Plasma heating offers high operating temperatures and high power densities. Lockheed proposes using a transferred arc plasma torch (Figure 3) to vitrify contaminated soils. A transferred arc uses the working materials (soil, in this case) as one of the electrodes. Therefore, in a transferred arc application, heating occurs via convection, radiation and electrical resistance. The transferred arc is the heat source. The plasma arc melts the material into a molten bath forming a glass that contains the immobilized waste product.

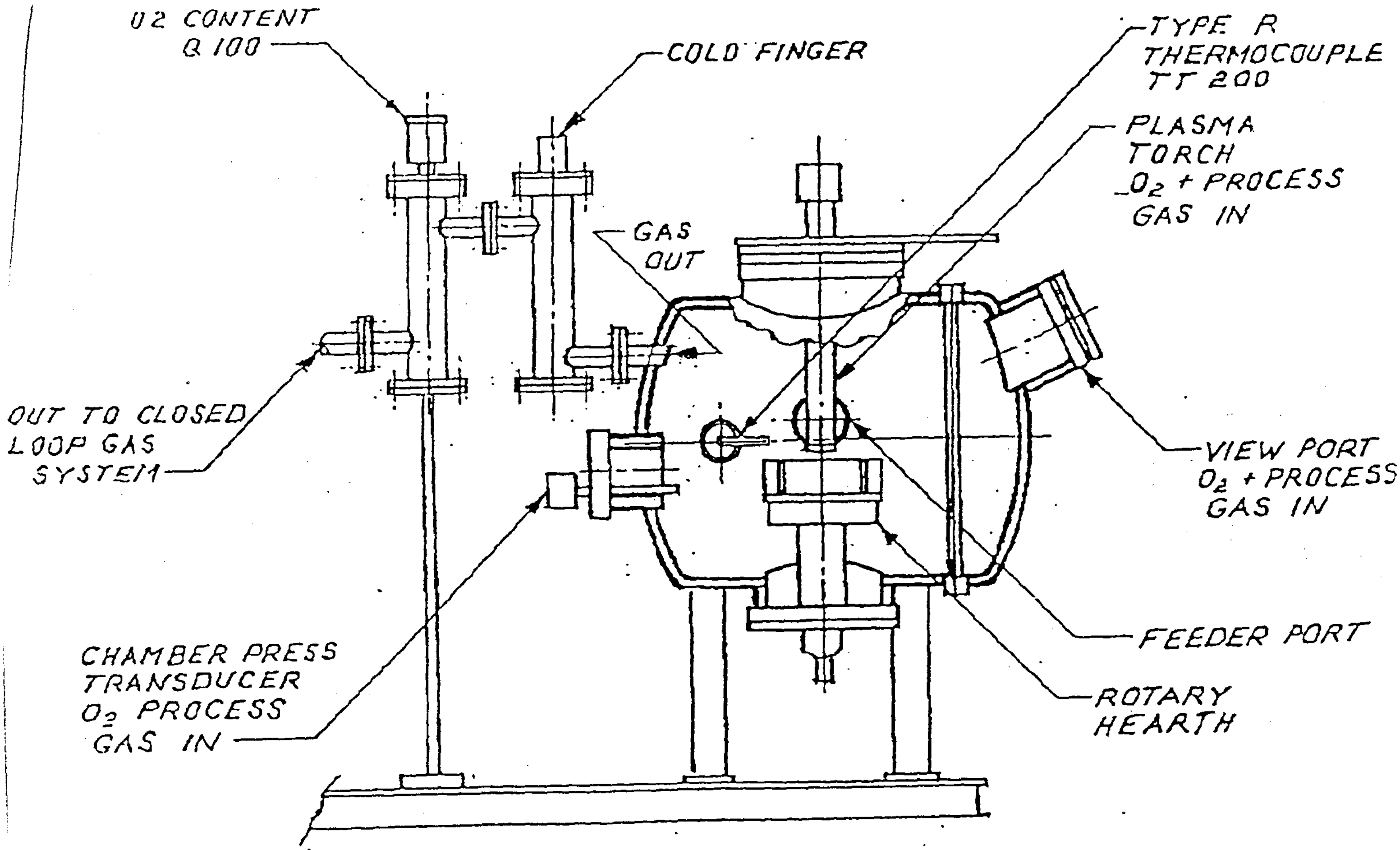
Metals and radioactive inorganic contaminants are not destroyed during vitrification. There are three possible pathways for metals and radionuclides during treatment: (1) chemical and/or physical immobilization in the glass product or metal precipitate, (2) removal in the off-gas treatment, (3) escape into the environment. The intent of this test is to physically immobilize the plutonium; however, the amount of plutonium that actually volatilizes into the off-gas will be determined. Organic material is destroyed almost immediately upon entering the melter chamber. Off-gases pass through a secondary combustion chamber and are cleaned before they are released. Pathway three, escape into the environment, will not be an option.

Preliminary testing has shown that the glassy waste product, or slag, meets all TCLP regulatory standards and that the process has a destruction and removal efficiency for organic compounds of greater than 99.99%. Theoretical calculations indicate that all or nearly all of the plutonium will remain in the slag during processing. A pilot scale, in-situ vitrification study produced a metal retention efficiency of 99.99% for Pu. Plutonium retention efficiency has not been determined using an ex-situ plasma melter. The purpose of the testing at Lockheed is to determine the percentage of plutonium that will volatilize in an ex-situ plasma melter.

Plutonium Volatility Test Description

The primary objective of the volatilization test is to close within 90% (±10%) a mass balance on a cerium oxide surrogate and on the plutonium, and to determine the percent of Pu volatilization. Cerium oxide is used as a surrogate for plutonium because cerium has a similar melting point to plutonium. The tests will be performed in a bench scale plasma furnace under conditions approximate to those in a full scale plasma centrifugal furnace. The most important parameters to be controlled for the bench scale tests to be comparable to the full scale furnace are the slag temperature, oxygen content of the furnace atmosphere and absolute pressure in the furnace chamber.

Figure 3
Plasma Melter Schematic



Four tests will be performed. The first two tests will use the cerium surrogate in the controlled for the bench scale tests to be comparable to the full scale furnace are the slag temperature, oxygen content of the furnace atmosphere and absolute pressure in the feed soil. The next two tests will use approximately 15 kilograms of Pu contaminated soil with an activity of about 2 nCi/g from Rocky Flats. After each test the slag, debris, filters and swipes taken from the furnace surfaces and the off gas system will be analyzed to determine what percentage of surrogate or plutonium has volatilized.

REFERENCES

EPA Handbook (May 1992) Vitrification Technologies for Treatment of Hazardous and Radioactive Waste. EPA/625/R-92/002.

Robbins, L.C. (February 1990) Soils Cleanup Using B.E.S.T. Solvent Extraction, in Hazardous Waste Treatment: Treatment of Contaminated Soils. Proceedings of an A&WMA International Symposium, Cincinnati, Ohio, p. 314.